Bootstrapping the Internet of the Future

Mohammad Shafahi
System and Network Engineering
University of Amsterdam
Feb 2012

Supervisors:
Rudolf Strijkers
Marc X. Makkes
Research Question(s)

- What are the necessary architectural components to boot a Virtual Internet?

- Can a Virtual Internet provide more efficient routes between nodes than the current Internet does?
• Computing will be available everywhere any time

• With computing everywhere it is possible to create virtual networks with different optimization
Cloud Infrastructure

• Growing Number of Cloud Providers
  - Amazon
  - Brightbox
  - ...

• Clouds Distributer Across the globe:
  - North America
  - Europe
  - Asia
  - ...
Virtual Internet Architecture

- Routers are Virtual Machine
- Connected through Tunnels
- A Controller Manages the Routers
Virtual Internet OS

- Creates an Abstraction for the User
- The user still has access to other layers
Configuration Resolver

- 5 Gb Ram, Japan
- 3 Gb Ram, France
- 8 Gb Ram,

- R1
- R2
- R3

- Resolves Configuration Requirements to Router Names
- If no Router exists with this configuration it creates one
- It can create a Router based on configuration request
Provider Resolver

- R1
  - Amazon EC2 AP,V1
- R2
  - Amazon EC2 WA,V2
- R3
  - Amazon EC2 EA,V1

- Router Names to Virtual Machines
- If no Virtual Machine exists for the Router it creates one
Cloud (Provider) API

- Cloud API
  - Provides a single interface to all the clouds
  - Examples: Ruby cloud, Apache Libcloud, ...

- Cloud Provider API
  - Amazon API
  - ...

Applications

• Network Evolution
  ▪ Change in the convergence Layer
  ▪ Research cost (Test bed cost)

• Application Specific Optimization
  ▪ Online Gaming
  ▪ Online Surgery!!
  ▪ Avoid faulty or misbehaving paths

• Online changes
  ▪ Measure and change based on while running
What we can't do

- We can't control the routing of the Internet
  - Paths are mainly economical efficient
  - QoS only sets priority but not path

- We can't relocate our Routers
  - Time consuming
  - Costs a lot
What we can do

- Control Endpoints
- Create Virtual Machines
Example

- Internet Path (14):
  - [AS65534]
  - [AS38895](2)
  - [AS23730](2)
  - [AS10026/AS1221]
  - [AS10026](4)
  - [AS4589]
  - [AS12871](3)

- V-Internet Path (15):
  - [AS65534]
  - [AS38895](2)
  - [AS23730](2)
  - [AS2914](3)
  - [AS3292]
  - [AS2914]
  - [AS3292]
  - [AS1200]
  - [AS12871](3)

- Internet: 335.18 ms
  27.15 % Improved

- V-Internet: 244.17
Test Setup - NLNOGRING

- RING nodes: 75
- ASs: 72
- Countries: 21
Amazon EC2

- Singapore
- Tokyo
- Europe(Ireland)
- North California
- Oregon
- Virginia
- Sao Paulo

- Nodes: 17
- Countries: 5
Test Setup Controller Commands

- Deploy
  - Send Setups to VMs
- Install
  - Run Install script on VMs
- Run
  - Run Tests on VMs
- Retrieve
  - Retrieve the results from Vms
- Reset
  - Reset VMs to original state
- Status
  - Show status of Vms (Based on Logs Collected)
Improvement in Latency(1)

Note: This is only a snapshot in time
Improvement in Latency(2)

Note: This is only a snapshot in time
Improvement Distribution

Note: This is only a snapshot in time
Note: This is only a snapshot in time
Conclusions

- In 78% of the cases the Virtual Internet can provide a more optimal path based on latency than the current Internet paths.
- There are cases with more than 50% improvement.
- In almost 12% of the cases you only get 1ms improvement but that could be a life saver (Online Surgery).
Future work

- Account stability of the Virtual Internet
- Study on the Internet governance issues of the Virtual Internet
- A paper will be published based on the results of this research
Special Thanks

- Job Snijders that provided access to the NLNOGRING
Questions

mohammad.shafahi@os3.nl